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(54) An hydraulic accumulator and an hydraulic impacting device with same.

(57) An hydraulic impact device for example a jack hammer has an hydraulic accumulator in the form of a tube (34) of glass fibre reinforced epoxy. The tube is coaxial with the hammer piston (16). The elasticity of the tube and the resulting forces in the tube itself provide for the accumulating capacity. Thus, there is no spring but the wall itself.

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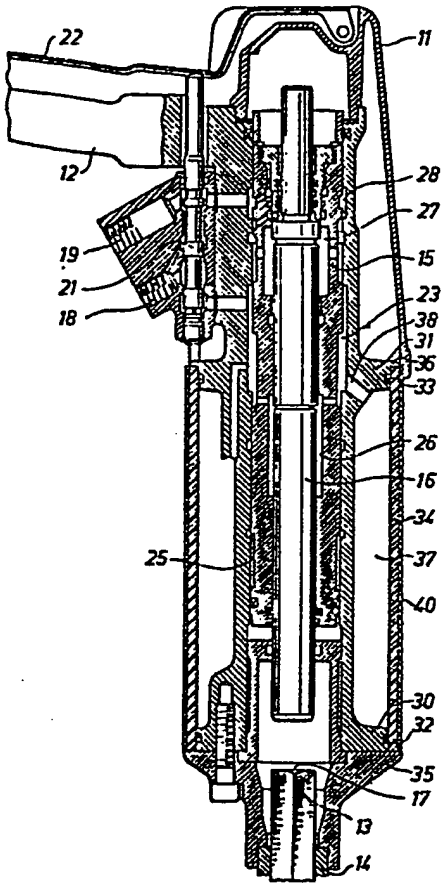
Fig.1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An hydraulic accumulator and an hydraulic impacting device with same

This invention relates to an hydraulic accumulator that has an accumulator chamber that is at least partly defined by an elastic wall. The invention relates also to an hydraulic impact device that comprises such an acculmulator. It relates also to a method of accumulating a pressure liquid.

Most prior art hydraulic impact devices in the form of rock drilling machines, jack hammers, and chisel hammers have an accumulator. Usually, the accumulator has an elastic wall in the form of a rubber membrane that separates a liquid chamber from a nitrogen filled chamber so that the gas acts as a spring on the membrane. An impact device with such an accumulator is shown in US-A 3766830 and an accumulator of this kind is shown in more detail in US-A 3948288. The variation of life of such rubber membranes is often considerable and some of the individual membranes have a very short life. Another disadvantage is that one must add nitrogen regularly.

The liquid used for operating the impact device, usually hydraulic oil, has a certain compressibility and, by US-A 3620312 and 4282937,impact devices are known which utilizes this inherent compressibility of the liquid, Then, the accumulator chambers have large volume and are confined by steel walls. Often, the accumulator chambers can not be made as large as desirable.

It is an object of the invention to provide an accumulator that is simple, cheap and comparatively small and which is suitable for impact devices. This object is achieved by the features given in the characterizing parts of the claims.

The invention will be described with reference to the accompanying drawings.

Fig 1 is a longitudinal section through an hydraulic jack hammer on which the invention is applied.

Fig 2 shows at a larger scale a seal shown in Fig 1.

The hydraulic impact device in the form of a jack hammer as shown in Fig 1 has a plural part housing 11 with two handles that are in an angle to each other so that only one of the handles 12 can be seeen on the figure.

A work tool in the form of a chisel has a hexagonal shank 13 that is inserted in the front portion of the housing 11 and it is retained there by means of a non-illustrated conventional chisel holder. A non-illustrated collar on the chisel 13 takes support on the housing 11 in a conventional way so that a feed force can be transmitted from the housing 11 to the chisel 13 and so that the chisel will have a defined axial position in the housing 11. The housing 11 forms a cylinder for an axially movable lining 15 which in its turn forms a cylinder for a hammer piston 16 that is axially movable in the lining 15. The hammer piston 16 is arranged to periodically impact on the end face 17 of the chisel shank. The end face 17 forms thus an anvil surface for the hammer piston 16.

The housing has an inlet 18 for the pressure liquid, usually hydraulic oil, and an outlet 19. An inlet chamber 23 can be pressurized by means of a valve 21 that is controlled by means of a trigger 22. There are a cylinder chamber 25 between the lining or cylinder 15 and the housing 11 and a cylinder chamber 26 between the cylinder 15 and the hammer piston 16. The cylinder 15 has the function of a valve that alternately couples a cylinder chamber 27 between the cylinder 15 and the hammer piston 16 to the inlet chamber 23 and to an outlet chamber 28. Thus, both the cylinder 15 and the hammer piston 16 reciprocate and since the forces between the cylinder 15 and the housing 11 are applied continuously and are not fluctuating, the operation of the hammer piston will not induce vibrations on the housing 11. The impact motor is not described in detail but reference is made to EP-A-133609 that describe an impact motor of this kind. The housing 11 has two annular walls 30, 31 with grooves for annular seals 32, 33 as is best shown in Fig 2. A tube 34 of glass fibre reinforced plastics is supported by these seals

32, 33 and the tube is axially affixed by means of shoulders 35, 36 of the housing 11. The tube 34 should not be axially clamped but should preferably have a small axial play to the housing 11. Inside the tube 34, an accumulator chamber 37 is formed which is constantly coupled to the inlet chamber 23 by means of a bore 38. Thus, the tube 34 itself can be considered as a part of the housing 11. The accumulator chamber 37 and the tube 34 are arranged both around a part of the cylinder 16 for the hammer piston 15 and around a part of the cylinder for the cylinder 16. The cylinder for the cylinder 16 is formed by the housing 11.

The tube or cylinder 34 has a filament winding, e.g. glass fibre, with a small pitch and the matrix comprises a thermoset for example epoxy or vinyl esther. Such a tube will have high linear strain tangentially at fatigue strength which is the characteristic that makes a large accumulator capacity. The wall thickness of the tube 34 should be chosen such that, in operation, the stress will be at a suitable level below the fatigue strenth. The accumulating capacity that results from the compressibility of the hydraulic fluid will then be smaller than the accumulator capacity that results from the elasticity of the tube 34; the quotient will be less than 1 or even less than ½. Thus, the elasticity of the wall of the tube will provide for the main portion of the accumulating capacity.

The tube 34 can have an outer protective layer 40 of unreinforced wear resistant resin or plastics. The tube 34 can also have an unreinforced sealing layer of resin or plastics on its inner side. These two layers are probably not necessary but one or both of them can be omitted. They need not be of the same resinous material as the reinforced part of the tube wall. As an alternative to an inner layer as described, a sealing rubber layer can be vulcanized to the tube 34 on the interior of the tube wall. It might be a risk that an unsealed tube can transpire oil, which has no effect on the function but may be unpleasant. Since the ends of the tube 34 are not clamped but they are only supported by the seals 32, 33, the tube is comparatively evenly stressed and fatigue breakdown is avoided. Also

other ways of mounting the tube 34 may work, for example clamping of the ends. The tube 34 can be manufactured in a continuous mode and then cut into suitable pieces.

A glass fibre filament winding with a small pitch seems to be preferable since it will provide a tube with very high strain at fatigue strength. The strain will exceed 0.2% or even exceed 0.5%. Any other material having this property could be used as an alternative.

Instead of the protective layer 40 of the tube 34, another tube can be arranged outside the tube 34 spaced therefrom.

The elastic wall of the accumulator is shown as a tube 34 with a circular cross section. Such a design seems preferable. The elastic wall could, however, have another form. It could for example be a circular plate that is sealed off around its periphery, or it could be in the form of a bubble for example a sphere.

In the above described impact device, the accumulator is continuously pressurized in operation since it is continuously coupled to the inlet 18, and it reduces the cyclical pressure fluctuations in the inlet. An accumulator of the kind described can also be used in an impact device that has an accumulator that is alternately coupled to the supply and to the outlet, for example an impact device of the kind described in US-A-3620312.

Claims:

1. Hydraulic accumulator that has an accumulator chamber at least partly defined by an elastic wall,
c h a r a c t e r i z e d i n
that the elastic wall (34) comprises a fibre reinforced matrix.

2. Hydraulic accumulator according to claim 1,
c h a r a c t e r i z e d i n
that the matrix comprises a thermoset.

3. Hydraulic accumulator according to claims 1 or 2,
c h a r a c t e r i z e d i n
that the fibre reinforcement comprises a filament winding.

4. Hydraulic accumulator according to any one of the claims 1-3,
c h a r a c t e r i z e d i n
that the fibre reinforcement comprises glass-fibres.

5. Hydraulic accumulator according to any one of the claims 1-4,
c h a r a c t e r i z e d i n
that the elastic wall comprises a tube (34) that is supported by sealing rings (32, 33) on end walls (30, 31) that partly define the accumulator chamber (37).

6. Hydraulic accumulator that has an accumulator chamber (37) at least partly defined by an elastic wall (34),
c h a r a c t e r i z e d i n
that the elastic wall comprises tube (34) that is supported on annular seals (32, 33) on end walls (30, 31) that partly define the accumulator chamber (37).

7. Hydraulic accumulator according to claim 6,
c h a r a c t e r i z e d i n
that said seals are lip sealing rings (32, 33).

8. Hydraulic impact device comprising a cylinder (11, 15), a hammer piston (16) that is reciprocable in the cylinder to repetitively impact on an anvil (17) that is coupled to a work tool (13), and a hydraulic accumulator (37) that is at least partly defined by an elastic wall (34),
c h a r a c t e r i z e d i n
the elastic wall comprises a fibre reinforced matrix.

9. Impact device according to claim 8,
c h a r a c t e r i z e d i n
that the elastic wall comprises a tube (34) that is supported by annular seals (32, 33) on end walls (30, 31) that partly define the accumulator chamber (37), said tube (34) being arranged around at least a part of the cylinder.

10. Hydraulic accumulator that has an accumulator chamber that is at least partly defined by an elastic wall,
c h a r a c t e r i z e d i n
that the elastic wall comprises a tube (34) that is supported by annular seals (32, 33) on end walls (30, 31) that partly define tha accumulator chamber (37), said tube (34) being arranged around at least a part of the cylinder.

11. Method of accumulating a pressure liquid with fluctuating pressure, comprising using an accumulator chamber that has an elastic wall (34),
c h a r a c t e r i z e d i n
using such a combination of a fluid pressure and an elastic wall (34) that the elastic tension and the inherent forces of the wall itself provide for the main portion of the accumulating capacity.

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Fig.1

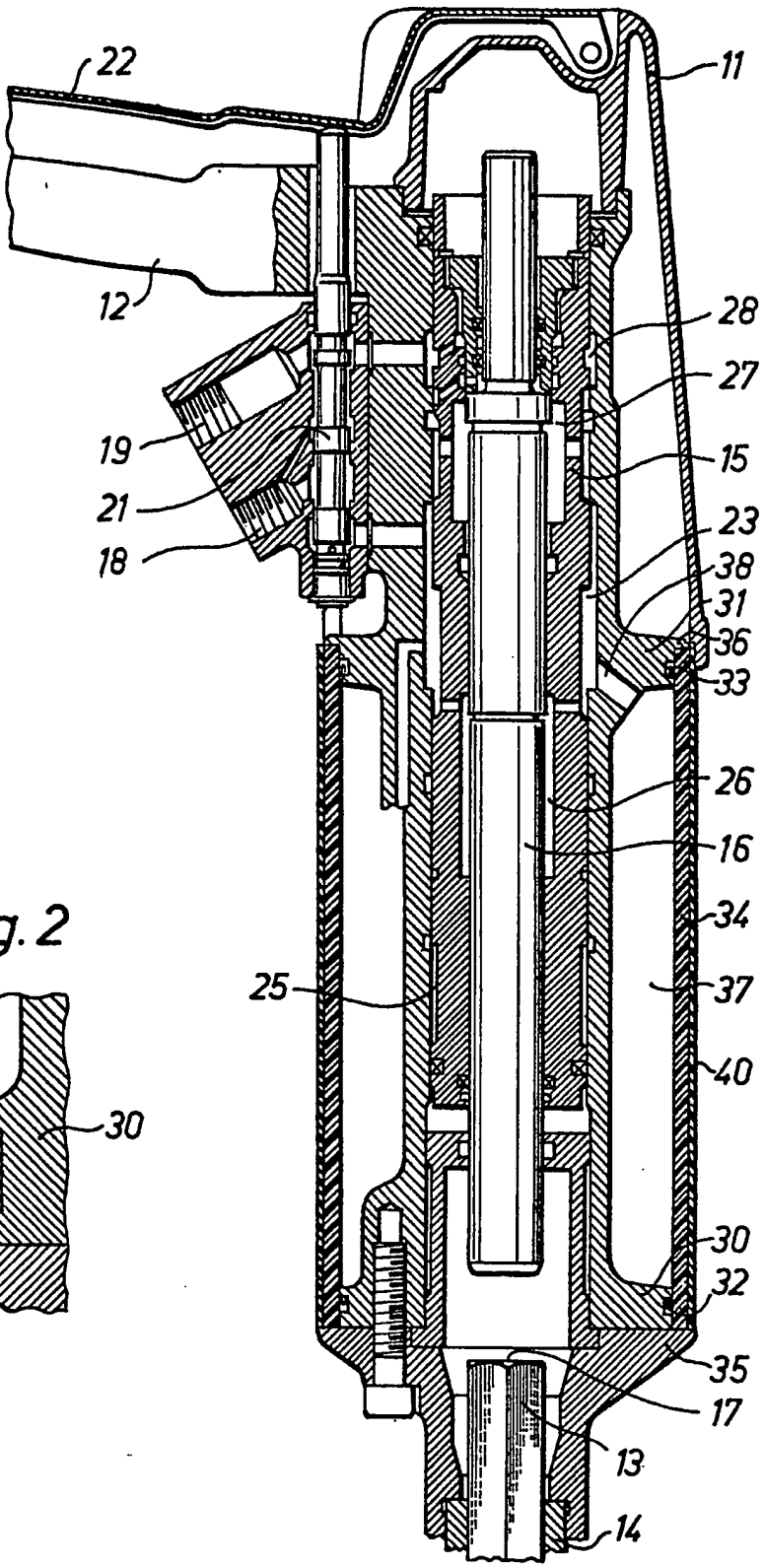

Fig. 2